



National Institute of Standards and Technology

Certificate of Analysis

Standard Reference Material[®] 2260a

Aromatic Hydrocarbons in Toluene

This Standard Reference Material (SRM) is a solution of 36 aromatic hydrocarbons, primarily polycyclic aromatic hydrocarbons (PAHs) ranging in molecular mass from 128 amu to 302 amu in toluene. This SRM is intended primarily for use in the calibration of chromatographic instrumentation used for the determination of aromatic hydrocarbons, primarily PAHs. A unit of SRM 2260a consists of five 2-milliliter ampoules, each containing approximately 1.2 mL of solution.

Certified Concentrations of Constituents: A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or accounted for by NIST. The certified concentration values and estimated uncertainties for the 36 constituents, expressed as mass fractions, are given in Table 1 along with the Chemical Abstract Service (CAS) Registry Numbers. The certified concentration values are based on results obtained from the gravimetric preparation of this solution and from the analytical results determined by using gas chromatography.

Expiration of Certification: The certification of this SRM lot is valid until **31 January 2014**, within the measurement uncertainties specified, provided the SRM is handled and stored in accordance with the instructions given in this certificate. However, the certification is nullified if the SRM is damaged, contaminated, or modified. NIST reserves the right to withdraw, amend, or extend this certification at anytime.

Maintenance of SRM Certification: NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet) will facilitate notification.

The coordination of the technical measurements leading to the certification of this SRM was under the direction of M.M. Schantz and S.A. Wise of the NIST Analytical Chemistry Division.

Preparation and analytical measurements of the SRM were performed by D.L. Poster and M.M. Schantz of the NIST Analytical Chemistry Division.

Ampouling was performed by M.M. Schantz of the NIST Analytical Chemistry Division and M.P. Cronise and C.N. Fales of the Standard Reference Materials Program.

Consultation on the statistical design of the experimental work and evaluation of the data were provided by S.D. Leigh of the NIST Statistical Engineering Division.

The support aspects involved in the issuance of this SRM were coordinated through the NIST Standard Reference Materials Program by B.S. MacDonald of the NIST Measurement Services Division.

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Certificate Issue Date: 03 December 2004

NOTICE AND WARNING TO USERS

Handling: This material contains polycyclic aromatic hydrocarbon compounds, many of which have been reported to have mutagenic and/or carcinogenic properties, and should be handled with care. Use proper disposal methods.

Storage: Sealed ampoules, as received, should be stored in the dark at temperatures between 10 °C and 30 °C.

INSTRUCTIONS FOR USE

Sample aliquots for analysis should be withdrawn at 20 °C to 25 °C **immediately** after opening the ampoules and should be processed without delay for the certified values in Table 1 to be valid within the stated uncertainty. Because of the volatility of toluene, certified values are not applicable to material stored in ampoules that have been opened for more than 5 minutes, even if they are resealed.

PREPARATION AND ANALYSIS

The compounds used in the preparation of this SRM were obtained from commercial sources or as Certified Reference Materials (CRMs) from the Institute for Reference Materials and Measurements (formerly BCR), Geel, Belgium. The solution was prepared at NIST by weighing and mixing the individual compounds and toluene. The weighed components were added to the toluene and mixed overnight. The total mass of this solution was measured, and the concentrations were calculated from this gravimetric procedure. These gravimetric concentrations were adjusted for the purity estimation of each component, which was either determined by using flame ionization capillary gas chromatography with two stationary phases of different polarities and differential scanning calorimetry or through the use of CRMs. The bulk solution was then chilled to approximately –5 °C, and 1.2 mL aliquots were dispensed into 2-milliliter amber glass ampoules, which were then flame sealed.

Aliquots from nine ampoules, selected using a random stratified sampling scheme, were analyzed in duplicate by using gas chromatography/mass spectrometry with a moderately polar 50 % phenyl methylpolysiloxane phase and a shape selective liquid crystalline phase (50 % dimethyl/liquid crystalline polysiloxane). The internal standard solution added to each sample for quantification purposes was prepared from SRMs 2269 and 2270, Perdeuterated PAH-I and Perdeuterated PAH-II, respectively, in Hexane/Toluene. Calibration solutions, consisting of weighed amounts of the compounds and the internal standard solution in toluene, were chromatographically analyzed to determine analyte response factors.

Table 1. Concentrations of Components in SRM 2260a

Compound	CAS Registry No. ^(a)	Certified Concentration	
		($\mu\text{g/g}$)	($\mu\text{g/mL}$) ^(b)
Naphthalene	91-20-3	11.43 \pm 0.30 ^(c)	9.89 \pm 0.26
Biphenyl	92-52-4	5.61 \pm 0.14 ^(c)	4.85 \pm 0.12
Acenaphthylene	208-96-8	6.26 \pm 0.20 ^(c)	5.41 \pm 0.17
Acenaphthene	83-32-9	5.55 \pm 0.13 ^(c)	4.80 \pm 0.11
Fluorene	86-73-7	4.71 \pm 0.11 ^(c)	4.07 \pm 0.10
Dibenzothiophene	132-65-0	4.39 \pm 0.17 ^(c)	3.80 \pm 0.15
Phenanthrene	85-01-8	11.57 \pm 0.12 ^(d)	10.01 \pm 0.10
Anthracene	120-12-7	3.736 \pm 0.054 ^(d)	3.231 \pm 0.047
4 <i>H</i> -Cyclopenta[<i>def</i>]phenanthrene	203-64-5	2.32 \pm 0.11 ^(c)	2.01 \pm 0.10
Fluoranthene	206-44-0	8.324 \pm 0.087 ^(d)	7.200 \pm 0.075
Pyrene	129-00-0	8.949 \pm 0.083 ^(d)	7.741 \pm 0.072
Benzo[<i>ghi</i>]fluoranthene	203-12-3	3.414 \pm 0.045 ^(d)	2.953 \pm 0.039
Cyclopenta[<i>cd</i>]pyrene	27208-37-3	1.958 \pm 0.024 ^(d)	1.694 \pm 0.021
Benzo[<i>c</i>]phenanthrene	195-19-7	4.608 \pm 0.036 ^(d)	3.986 \pm 0.031
Benz[<i>a</i>]anthracene	56-55-3	4.415 \pm 0.078 ^(d)	3.819 \pm 0.067
Chrysene	218-01-9	4.62 \pm 0.11 ^(c)	4.00 \pm 0.10
Triphenylene	217-59-4	4.12 \pm 0.16 ^(c)	3.56 \pm 0.14
Benzo[<i>b</i>]fluoranthene	205-99-2	7.86 \pm 0.10 ^(d)	6.80 \pm 0.09
Benzo[<i>j</i>]fluoranthene	205-82-3	4.145 \pm 0.097 ^(c)	3.585 \pm 0.084
Benzo[<i>k</i>]fluoranthene	207-08-9	3.444 \pm 0.036 ^(d)	2.979 \pm 0.031
Benzo[<i>a</i>]fluoranthene	203-33-8	2.279 \pm 0.064 ^(c)	1.971 \pm 0.055
Benzo[<i>e</i>]pyrene	192-97-2	4.561 \pm 0.054 ^(d)	3.945 \pm 0.047
Benzo[<i>a</i>]pyrene	50-32-8	4.71 \pm 0.17 ^(d)	4.07 \pm 0.15
Perylene	198-55-0	4.430 \pm 0.045 ^(d)	3.83 \pm 0.039
Indeno[1,2,3- <i>cd</i>]pyrene	193-39-5	4.425 \pm 0.030 ^(d)	3.828 \pm 0.026
Benzo[<i>ghi</i>]perylene	191-24-2	5.669 \pm 0.069 ^(d)	4.904 \pm 0.060
Dibenz[<i>a,h</i>]anthracene	53-70-3	4.555 \pm 0.063 ^(d)	3.940 \pm 0.054
Dibenz[<i>a,c</i>]anthracene	215-58-7	2.912 \pm 0.026 ^(d)	2.519 \pm 0.022
Dibenz[<i>a,j</i>]anthracene	224-41-9	4.539 \pm 0.062 ^(d)	3.926 \pm 0.054
Picene	213-46-7	3.257 \pm 0.047 ^(d)	2.817 \pm 0.041
Benzo[<i>b</i>]chrysene	214-17-5	4.092 \pm 0.033 ^(d)	3.540 \pm 0.029
Anthanthrene	191-26-4	2.205 \pm 0.029 ^(d)	1.907 \pm 0.025
Coronene	191-07-1	2.255 \pm 0.033 ^(d)	1.951 \pm 0.029
Dibenzo[<i>a,h</i>]pyrene	189-64-0	2.911 \pm 0.095 ^(d)	2.518 \pm 0.082
Dibenzo[<i>b,k</i>]fluoranthene	205-97-0	1.646 \pm 0.068 ^(d)	1.424 \pm 0.059
Dibenzo[<i>a,e</i>]pyrene	192-65-4	2.277 \pm 0.023 ^(d)	1.970 \pm 0.020

^(a) Chemical Abstracts, Fourteenth Collective Index Guide, American Chemical Society: Columbus, Ohio (2001).

^(b) The concentrations listed in $\mu\text{g/mL}$ units were obtained by multiplying the certified values in $\mu\text{g/g}$ by the density of the solution at 22 °C (0.8649 g/mL). These concentrations are for use in the temperature range of 20 °C to 25 °C and an allowance for the change in density over this temperature range is included in the uncertainties.

^(c) The results are expressed as the certified value \pm the expanded uncertainty. The certified value is the mean of the concentrations determined by gravimetric and chromatographic measurements. The expanded 95 % uncertainty uses a coverage factor of 2 and includes both correction for estimated purity and allowance for differences between the concentration determined by gravimetric preparation and chromatographic measurements [1].

^(d) The results are expressed as the certified value \pm the expanded uncertainty. The certified value is the mean of the concentrations determined by gravimetric and chromatographic measurements. The uncertainty listed with each value is an expanded uncertainty about the mean, with coverage factor 3, calculated by combining a between-method variance [2] with a pooled, within method variance following the ISO and NIST Guides [1].

REFERENCES

- [1] ISO; *Guide to the Expression of Uncertainty in Measurement*; ISBN 92-67-10188-9, 1st ed.; International Organization for Standardization: Geneva, Switzerland (1993); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing Uncertainty of NIST Measurement Results*; NIST Technical Note 1297; U.S. Government Printing Office: Washington, DC (1994); available at <http://physics.nist.gov/Pubs/>.
- [2] Levenson, M.S.; Banks, D.L.; Eberhardt, K.R.; Gill, L.M.; Guthrie, W.F.; Liu, H.K.; Vangel, M.G.; Yen, J.H.; Zhang, N.F.; *An Approach to Combining Results from Multiple Methods Motivated by the ISO GUM*; J. Res. Natl. Inst. Stand. Technol., Vol. 105, No. 4, pp. 571–579 (2000).

Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-6776, fax (301) 926-4751, e-mail srminfo@nist.gov, or via the Internet at <http://www.nist.gov/srm>.